The future of conferences, today

Are virtual conferences a viable supplement to "live" conferences?

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We would like to share our experience of organizing a virtual conference: the T6SympoZOOM on specialized bacterial nanomachines called Type VI Secretion Systems. Others have recently discussed the concept of virtual meetings from an overview perspective [preprint: 1] or their experience of transforming a live meeting into a virtual one [2]. Here, we discuss our experience of organizing a "boutique" virtual meeting from scratch and convey participants' feedback. We hope that others who are thinking of organizing a virtual meeting will find our insights useful.

The birth of a virtual biology conference

COVID-19 has had a huge impact on our whole society, including the scientific community. We do not just mean our colleagues who work hard to understand and to fight the virus, but also experimental scientists such as ourselves who had to put their research on hold for the time being. While social distancing and home quarantine means that our students' projects are halted and that our trainees have to work from home, another "casualty" of the situation is the dissemination of data at scientific conferences.

Since online video conferencing platforms are booming, we decided to explore a virtual conference to bring our community together to stay up to date on the latest research. An added bonus is that our students and postdocs would have something to distract them from the chores of home office and could easily join as participants or even as presenters to gain valuable experience and exposure. The latter is especially relevant for younger scientists who are on the verge of transitioning to the next stage in their career, and whose plans have been affected by hiring freezes, travel bans, and social distancing.

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Our first step was to gauge the interest in our community using social media. Once we realized that the need is real, we invited 20 prominent group leaders to present their recent work online. Our email explained our reasons, and what we saw as the up side: "It's free; bring your own beer; you can wear your pajamas; you can bring your kids along (as long as you remain on mute); no speaker can go over allocated time; you are stuck at home and can't attend any other meetings anytime soon anyhow". The response was nothing short of exceptional: all but one replied with a resonating yes! From that point on, it took only 21 days until the conference took place. Can you imagine completing the logistics and administrative work for a live conference in such a short time frame? To give it some "real conference" feeling and sense of a community coming together, we prepared a meeting logo and a flyer to promote the conference, we published the finalized itinerary online, and we set up a hashtag for social media; many speakers used the conference logo in their presentations, which was heartwarming to see. Once we announced conference details on dates, times, and confirmed attendees, we set up a Google Form to monitor registration and collect information on participants (email addresses, institute, etc.). All of the promotion was performed via Twitter and word-of-mouth.

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Conference structure

Confirmed invited speakers were up to 15 time zones apart (from Taipei, Taiwan to Seattle, USA), making the decision on the time of day and the duration of each conference session challenging (Fig 1). Even more challenging was the realization that many participants are working from home with their children, which limits the time they can stay undistracted in front of a computer screen. Trying to be as inclusive as possible, we decided to split the conference into 3 consecutive days, with 2 hours of talks each day starting at 4 PM London time

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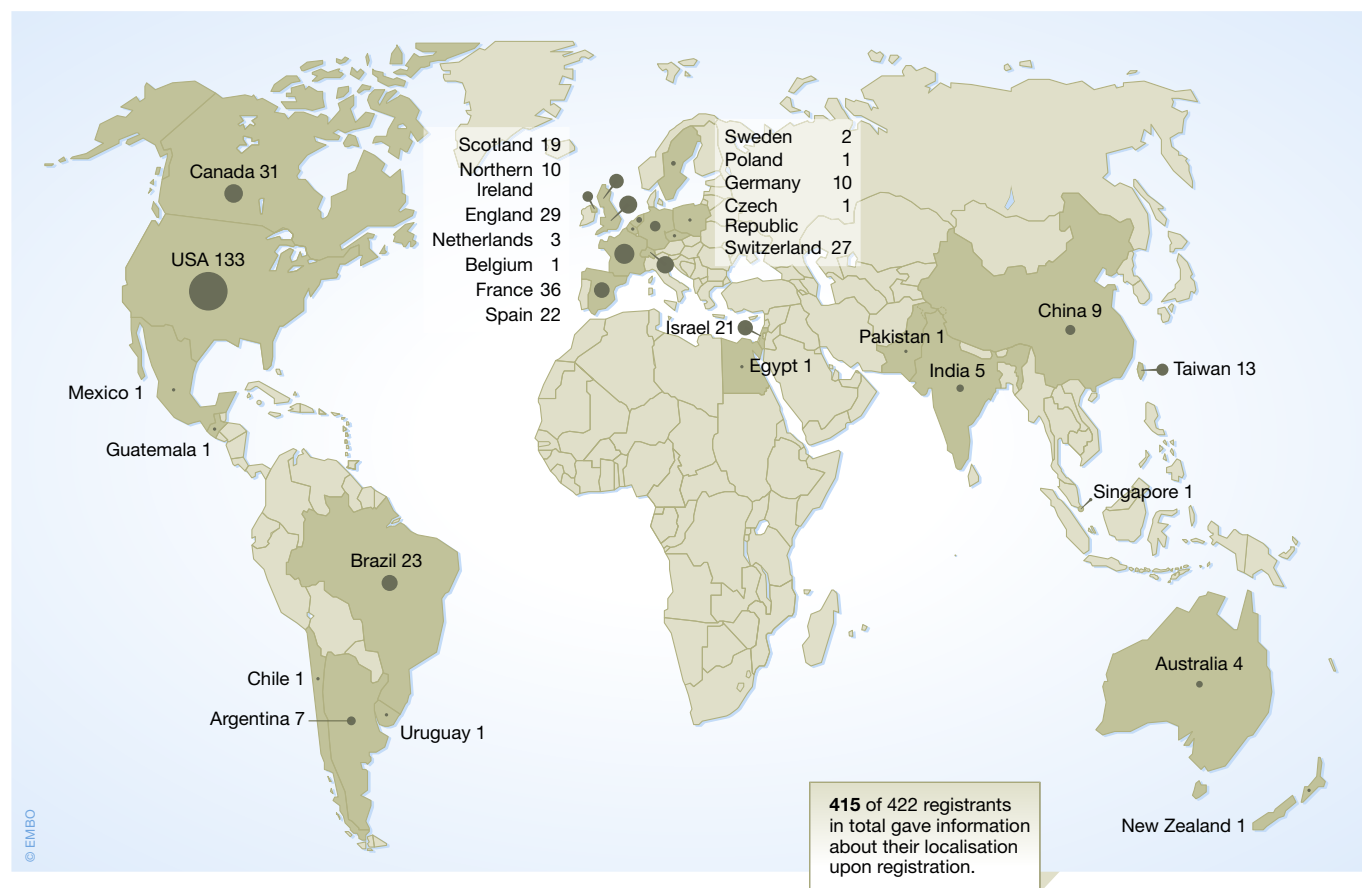   **Corresponding author. E-mail: mariofeldman@wustl.edu

Figure 1. International participation in the T6SymoZOOM virtual conference.
Distribution of countries in which T6SympoZOOM conference registrants were based. Numbers include only registrants who chose to disclose their home institute upon registration.

(corresponding to late night in Taipei, and early morning in Seattle). We also set the time limit as 10 minutes per talk and allowed 5 minutes for Q&A; each session comprised 7 talks. We included a 10-minute break to allow participants to freshen up.

About half of the invited principal investigators (PIs) decided to give the floor to one of their trainees; eventually, 12 out of the 20 talks were presented by trainees. We feel that this ratio of PI to trainee talks provided a well-balanced meeting in terms of the quality of the talks; it also provided a stage for trainees to improve their presentation skills and receive exposure in a setting that for some is less stressful than in front of a live audience.

At the end of day 2, we also had a panel discussion with journal editors (from EMBO Press and Cell Press) on the effects that COVID-19 and laboratory shutdowns may have on the peer-review process. We felt that some divergence from regular talks

would be refreshing, and we thought that this topic was worth addressing.

Technical aspects

We decided to use ZOOM to host our online conference, but of course other suitable online platforms are available. To minimize potential privacy issues, we provided 3 separate links, one for each session, and set a password. After playing around with the "meeting" option, we decided to use the "webinar". Although this platform requires a paid upgrade, it allowed us to accommodate more participants (500 instead of our initial 300 limit; we ended up having 422 registrants) and gave the hosts/moderators more control. On a side note, we strongly suggest that you set at least 2 co-hosts for the meeting. This will ensure that if one of the hosts experiences technical issues—one of us had a power outage during the last 10 min of day 2 and was disconnected—"the show" will go on.

The "webinar" platform also ensured a smoother video experience. To further reduce potential audio and video quality problems owing to limited bandwidth, we asked all participants to avoid excess usage of their internet during the conference hours and suggested, if possible, connecting their computer directly to the internet router via an Ethernet cable rather than relying on Wi-Fi connection. We were very pleased to experience no lags in video and audio streaming during the conference. Indeed, a post-conference poll indicated that attendees did not experience major issues with video and audio quality either. On a scale of 0–10 (0 being the worst and 10 being the best quality), 45% of the participants (out of a total of 186 responses) rated the technical quality of the meeting as 10, 34% as 9, 16% as 8, and the remainder rated it between 6 and 7.

The "webinar" platform divides the participants into 2 groups: the panelists, that is, the presenters, who can control their

own audio, video, and screen sharing; and attendees, who can only watch the panelists, and communicate via a chat box. Although this setup prevented unauthorized participants from sharing their screen and interrupting the meeting, this limitation was frustrating some attendees.

Attendees who wanted to ask a question after a talk could use the "raise hand" option of the "webinar" platform. As hosts, we saw their names going to the top of the list. One quick and simple option was to give them "permission to speak". However, to provide a more personal feel to the Q&A part, we temporarily promoted them to panelists, which allowed them to turn on their cameras and be seen by the speaker. It is worth noting that by doing the latter, we had to endure a ~10 seconds delay, at least for the first promoted attendee, since the system takes time to change these

designations. We also noted that many attendees posted additional questions on the Q&A box of the "webinar" platform and we prompted the speaker to reply in writing.

Notably, even though a virtual setup has some risks in terms of data confidentiality since we do not know who is listening or possibly recording the talks, many of our speakers chose to share unpublished results. Although we requested all attendees who received the conference links to respect data confidentiality and refrain from recording the talks, we of course had no way of enforcing it. Nevertheless, with the ubiquitous smartphone, even live closed meetings are not today immune to such unethical behavior.

Hindsight is 20/20

What have we learned from this experience, and how can virtual meetings become

better? The first thing to note is that out of 422 registrants (Fig 1), the peak number of attendees and panelists logged in was 327, 307, and 281 on days 1, 2, and 3, respectively. This means that you can take an example from airlines and "overbook" your conference (ZOOM meetings have a limit on the number of allowed participants, depending on the license you have). Some reasons behind these lower numbers could be the following: registration is free and easy, so people register even if they are not sure that they will tune in; registrants were planning on joining the sessions, but could not attend all sessions due to private or professional reasons; and, as we learned from comments left by registrants, the level of "commitment" was low for those who were not from the field. They registered because they thought that they can learn something new if they attend.

> **"***This means that you can take an example from airlines and "overbook" your conference...***"**

To get further feedback and ideas for improving future virtual conferences, we sent a link to all participants with a post-conference poll. More than 180 participants, speakers and attendees, responded. While some of our questions were more conference- and community-specific—desired frequency of the conference, satisfaction, and likelihood of attending another virtual meeting—others were more general in nature, and the answers suggested that the way we designed the schedule with 2-hour sessions, 3 consecutive days, and 10–15 minute talks was appreciated by most participants (Fig 2).

Three other comments and suggestions by multiple responders are worth considering for organizing future virtual conferences. First, permit attendees to turn on their cameras to make the conference more interactive and to provide a better sense of community. This is not a viable option in the ZOOM "webinar" platform, however, and will probably require the use of the regular "meeting" platform. It is also possible that too many participants turning on their cameras will overload the system and negatively affect the overall audio and video quality. It may also make meetings more vulnerable to cyber-attacks. Second, increase chances for social interactions. Chat rooms with speakers after the session or
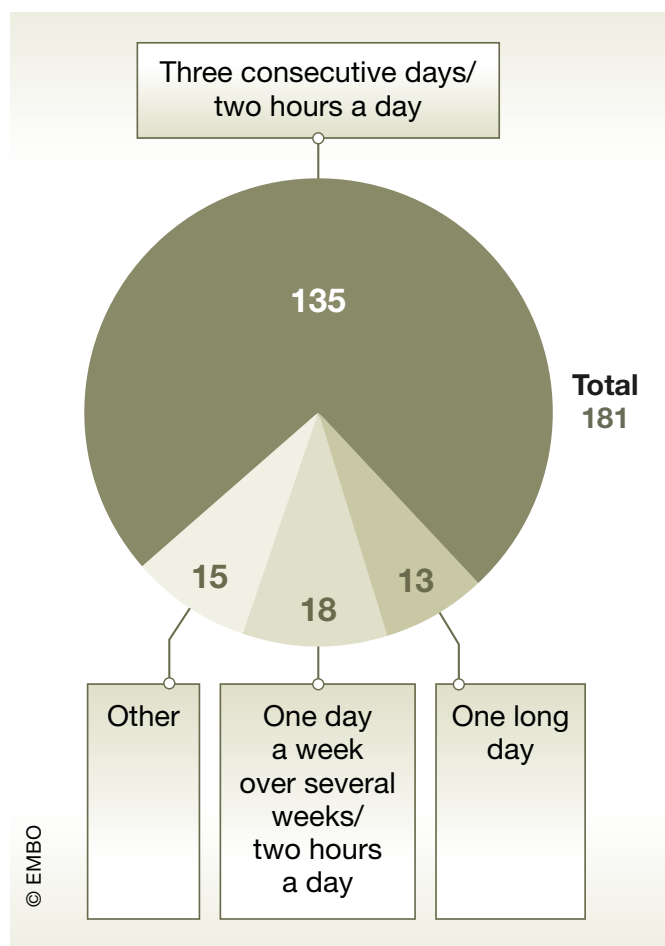

Figure 2. Virtual conference attendees prefer short sessions.
Post-conference input from T6SympoZOOM participants regarding their preferred virtual conference format.

during the break would give time for additional questions and debate. Similarly, open-discussion chat rooms would provide networking opportunities for trainees. These options do not have to be part of the video conference platform and can be set up in parallel using other platforms. Third, provide career panels for young researchers, including discussions about job prospects in the coming years, and possible changes to hiring and university policies post COVID-19.

> **"*Chat rooms with speakers after the session or during the break would give time for additional questions and debate.*"**

Summarizing the input from participants, we advise future virtual conference organizers to open chat rooms for participants to discuss the talks and to socialize, to hold "meet the speaker" round table session, and other socializing events. These will certainly help to alleviate the drawbacks of virtual conferences compared with live conferences and may make them more accessible and appealing to a wider crowd.

Virtual vs. live conferences

In our view and experience, there are various benefits and drawbacks to consider when organizing or participating in a virtual conference.

On the pro side is that virtual conferences are more inclusive. Scientists, and non-scientists, even younger students or short-term trainees—college undergraduates, laboratory technicians, post-bac students—who would otherwise not be able to attend a live conference for various reasons can participate. It is a low time- and financial commitment; it does not require traveling (thereby reducing carbon emissions [1]), there are no registration fees, and no need for accommodations. A virtual conference is considerably easier (financially and logistically) to organize than a live conference: it took us approximately 3 weeks to put together a conference with 20 talks and hundreds of participants. Physical distance and the option to leave the camera off may make shy trainees feel more comfortable and encourage them to ask questions. It facilitates geographic diversity. Live conferences are often biased by their location (e.g., FEBS conferences mostly attract European

participants, GRC conferences in the USA attract mostly American participants, etc.). In a virtual platform, it is simpler to get people from all over the place together (Fig 1) and the fact that participation is free allows people with limited resources to attend. The virtual setup also negates jetlag. Finally, you can enjoy great science from the comfort of your own home or office. And you can BYOB!

There are clearly a few cons compared to live conferences. There is less opportunity for mingling and forming collaborations if anyone can just log off after a talk or session. Being in a remote place at the same hotel with other participants for 4 days is clearly more suitable for social interaction. Attending from your home or the office could mean distractions by everyday life: one of the PI speakers had to deal with his baby girl crying in the background during his own talk. Although this may have been a bit distracting, it was also heartwarming to see professors are people too. Poster sessions are not practical in a virtual conference setting. Flash-talks (2–3 minutes) could instead provide trainees the opportunity to showcase their work and facilitate networking. Time differences may hinder participation from geographically remote areas. While we set the starting time of our meeting to 4 PM London time to be as accommodating as possible, it was still far from ideal for participants from Australia, the Far East, and Hawaii. One solution could be setting up regional virtual meetings.

What does the future (and present) hold?

Will virtual conferences replace live ones even after the current COVID-19 crisis is behind us? Probably not. And they should not. In our opinion, virtual conferences are a financially viable supplement to live conferences; they are an excellent choice for focused or "boutique" topics to bring together 100-500 participants with closely related interests, but less suitable for "mega-conferences" with thousands of participants from various disciplines. Although live conferences may become difficult to organize and fund, especially if a global recession follows this pandemic, live conferences still play a crucial role that cannot be adequately addressed by virtual ones. For example, the American Society for Microbiology (ASM) annual conference, which usually attracts ~10,000 attendees, plays a key role for forming connections, notably for graduate students trying to find a suitable laboratory for a postdoc.

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Lastly, the T6SS community has already decided that T6SympoZOOM will continue. More than 92% of our poll responders replied that they would like to participate in such a meeting every 6–12 months. So why not have a "virtual" GRC- or FASEB-like conference in alternate years when these traditional, successful, and necessary conferences are not taking place in the "real world"? No fundraising is needed, scientists from the whole world can attend for free, and great new ideas and collaborations can derive from such informal interactions. Although in-person conferences cannot be replaced by virtual ones, the latter are here to stay. We believe that the scientific community will take advantage of the technological advances that allow us to "get together" in a very cost- and time-effective way. Let us use this opportunity and make our science even more inclusive and available to others.

Conflict of interest

The authors declare that they have no conflict of interest.

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